# Space Weather Technical Forecast

Issued on Tuesday, 27 February 2024 at 13:22 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: R1/R2 remaining Likely.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Low over the past 24 hours, with X-ray activity recorded by GOES16 having been confined to low C-class and a peak flare of C3.4 at 27/0742UTC. This flare emanated from the largest and most complex sunspot group on the disc, AR3590. Changes within this group have become slow and minor. The umbra retrogression in the leading portion seen previously has slowed, and much has now faded to penumbra around the delta shear line between the positive leader and negative intermediate spot. This spot exhibits rather open and apparently stable magnetic field lines at present. Other spots were much simpler in comparison, though AR3595 continued a slow growth trend, and AR3596 remains a north-south magnetically aligned bipolar region in the far northeast.

There were no Earth-directed Coronal Mass Ejections (CMEs) observed in available coronagraph imagery.

**Solar Wind / Geomagnetic Activity:** Solar winds, as recorded at L1 by ACE were indicative of a CIR and a weak connection to a coronal hole fast wind. Solar wind speeds have been generally slightly elevated, around 400-450 km/s. Density has remained around average. The interplanetary magnetic field, IMF Bt, rose from weak to moderate, peaking 8nT at 26/2359 UTC before gradually falling, ending the period at weak, 4nT. The north-south component was mostly weak and positive (northward) but with a notable sustained negative (southward) period between 26/2200-27/0500 UTC. The phi angle has been largely negative (towards the Sun) in the past 24 hours, though with some fluctuations to positive (away from the sun) at a similar time to the more sustained period of -Bz stated above, possibly suggesting CIR effects. The net result of the above solar wind measures was generally Quiet to Unsettled (Kp 1-3) with one G1/Minor Storm interval (Kp 5) at 27/0300-0600 UTC.

**Energetic Particles / Solar Radiation:** GOES18 high energy (greater than 10MeV) proton flux was at Background levels.

Electron flux (greater than 2MeV) observed at GOES16 has been at Normal Background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 27/0000UTC was 1.05e6 integrated pfu on a level trend.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Further M-class flares are still Likely, with an ongoing Slight Chance of X-class. This risk is assessed as being constant through the four-day period, with the behaviour of AR3590 the dominant consideration.

**Solar Wind / Geomagnetic Activity:** No CMEs feature in this forecast period. Weak enhancements from CH01/- and perhaps CH03/- are possible in the next two days, though their effects are expected to be limited. Geomagnetic activity is expected to be Quiet to Unsettled throughout, with a chance of Active intervals days 1 and 2 (27/28 Feb).

**Energetic Particles / Solar Radiation:** Solar radiation storms of S1 and above are a rising

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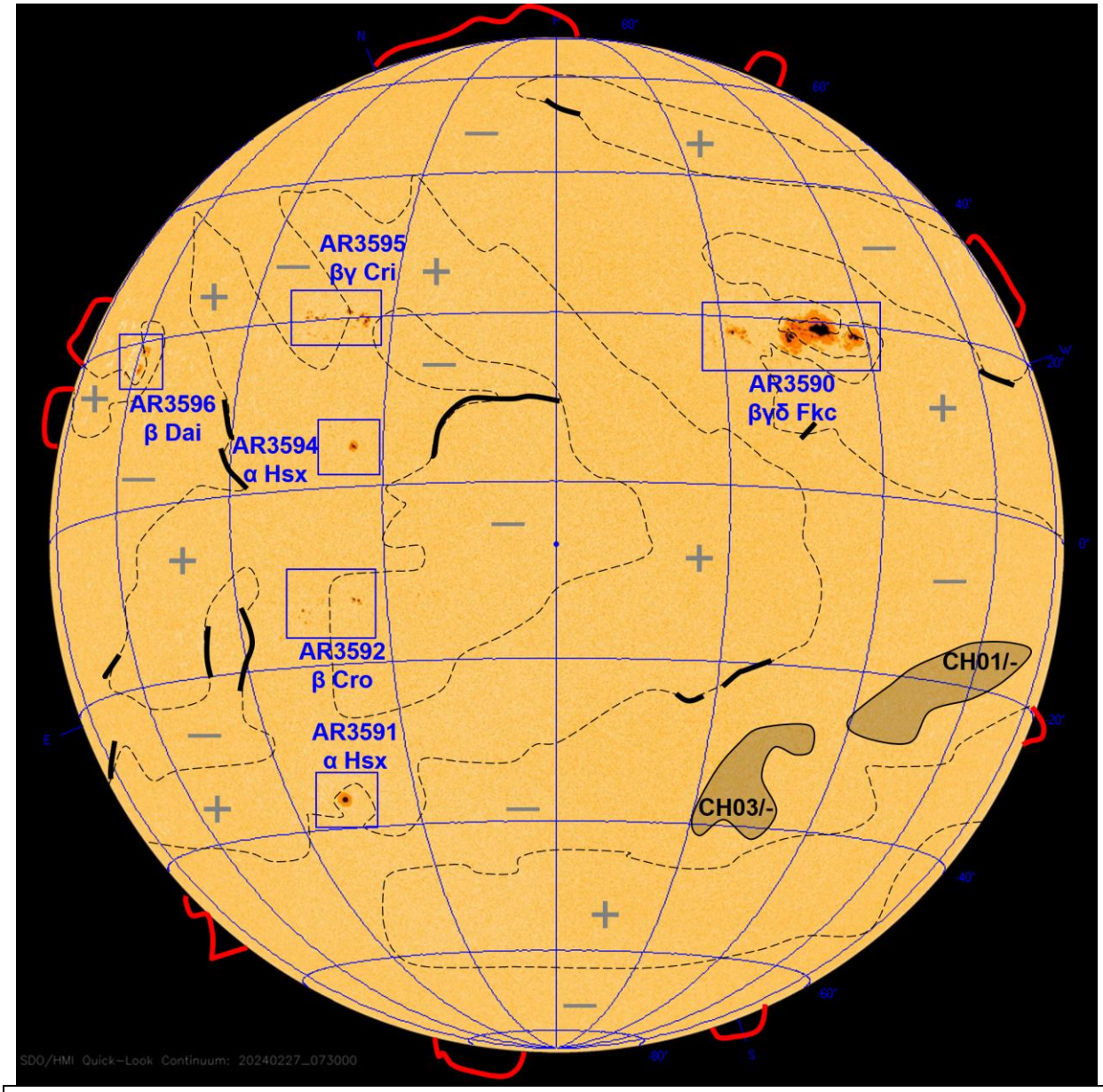
Slight Chance day-on-day, with the main risk factor being any proton-rich flares from AR3590, which is nearing a potent position should it flare appropriately.

High energy electron flux is expected to remain at background or perhaps moderate levels throughout the coming four-day period. 24-hour integrated fluence should remain below Active throughout.

**Figure 1. Solar Analysis Valid 27/0800 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

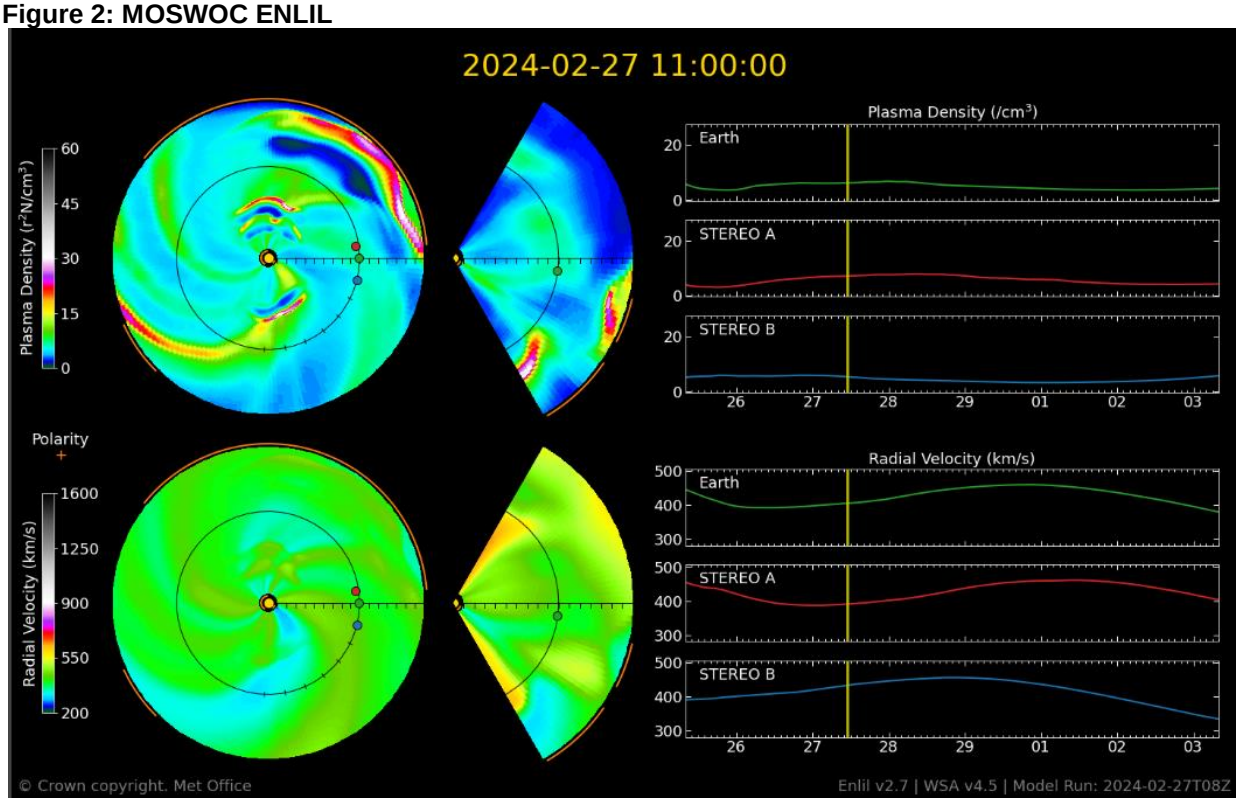
No CMEs feature in this forecast period.

The main coronal hole due in the period was expected to be CH01/- with speeds near 500km/s, though Enlil did have this missing to the south of Earth. It is thought that the slightly elevated wind speeds and increase in temperature may be signalling a very weak connection to this high speed stream since 26 Feb. This may continue over the next couple days, perhaps combining with the HSS from CH03/-, but solar wind speeds are also equally likely to wane through the period.

Geomagnetic activity is expected to be Quiet to Unsettled throughout, with a chance of Active intervals days 1 and 2.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 5 | 5 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: MOSWOC ENLIL**

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## Radio Blackouts - X-Ray Flares:

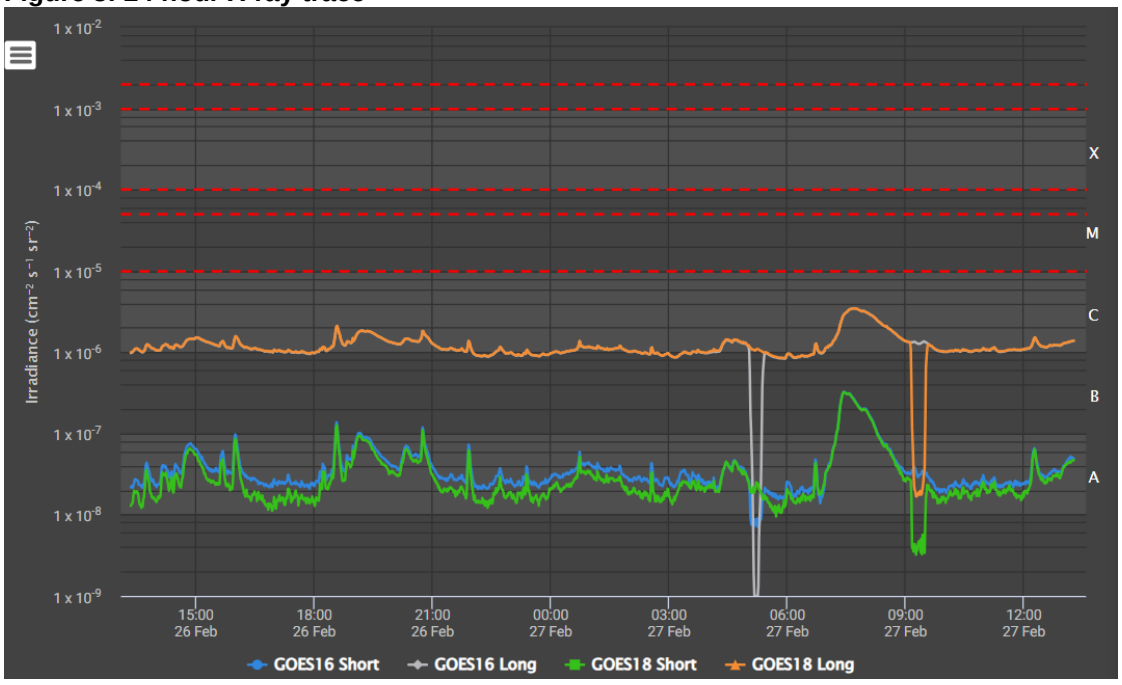
Activity is Likely to become Moderate, with further M-flares possible and a slight chance of rising to High with isolated X-flares, primarily from AR3590.

There are now six numbered regions on the disc. AR3590 remains by far the largest and most complex spot. Changes within this group have become slow and minor. The umbra retrogression in the leading portion seen previously has slowed, and much has now faded to penumbra around the delta shear line between the positive leader and negative intermediate spot. This spot exhibits rather open and apparently stable magnetic field lines at present. Other spots were much simpler in comparison, though AR3595 continued a slow growth trend, and AR3596 remains a north-south magnetically aligned bipolar region in the far northeast.

All of the current front-sided groups should remain on the Earth-facing disc in the period, and while there are suggestions of possible returning regions, these are not expected to rival the contribution from AR3590 in daily flare risk, and the chances of Moderate activity are held constant through the four days.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 60 | 60 | 60 | 60 |
| Very Active | R3 to R5 X Class | No | 10 | 10 | 10 | 10 |

**Figure 3: 24 hour X-ray trace**

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## Solar Radiation Storms - (High Energy Protons):

The current hiatus in activity from AR3590 and its historical lack of any proton enhancement visible at Earth from recent M and X-class flares means that the chances of S1 or greater are now considered slightly lower overall, although they do rise as this sunspot group migrates towards the better-connecting western limb should it flare appropriately. Contributions from other frontside spots are considered negligible.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 15 | 15 | 20 | 20 |
| **Very Active** | **≥ S3 *** | No | 2 | 2 | 5 | 5 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is currently firmly rooted in Normal Background territory, and this trend is now expected to continue.

No feature of the past several rotations has proven capable of significantly raising electron populations at GEO, and with CH01/- underwhelmingly muted, the only real driver to change this now appears far less likely to be impactful. MOSWOC REFM's thoughts in persisting current 24-hour integrated electron fluence levels well below the Active threshold are therefore considered accurate and are followed here.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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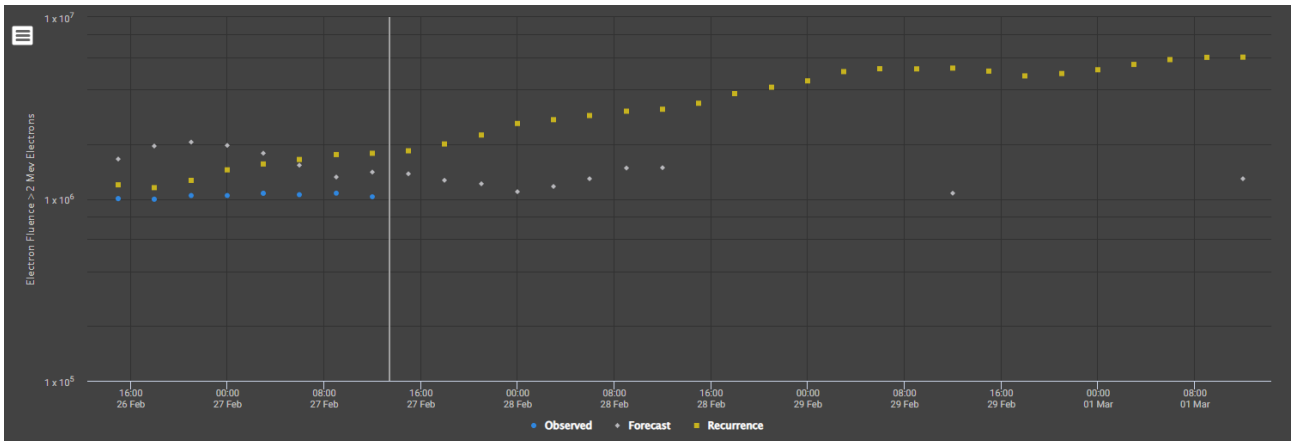
**Figure 5: MOSWOC REFM integrated flux forecast/observations/recurrence.**



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